AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings of claims in the application:

LISTING OF CLAIMS:

1-63 (cancelled)

64. (new): Optical device, apt to generate and process optical codes at at least one wavelength, comprising $P$ inputs $s$, with $1 \leq s \leq P$, and $P \geq 1$, and $N$ outputs $k$, with $1 \leq k \leq N$ and $N \geq 1$, characterised in that it is apt to simultaneously generate and process $N_C$ phase and/or amplitude optical codes at one or more wavelengths, with $N_C \geq 2$, made of $C$ chips with time interval $\tau$, with $C \geq 2$, characterised in that the transfer function $T_{sk}(f)$ from the input $s$ to the output $k$ satisfies the following formula:

$$\left| T_{sk}(f) \right| = \prod_{v=0}^{V-1} \left| F_v \left( a_v f + \frac{S_{sk}}{N_k \tau} \right) \right| \quad , \text{ for } \quad s = 1,2..P \quad k = 1,2,...N$$

where:
- $F_v(f)$ is a transfer function of an optical filter, for $v = 0,1,...,V-1$,
- $a_v$ is a constant value, for $v = 0,1,...,V-1$,
- $S_{sk}$ is an integer number ($S_{sk} \in Z$),
- $N_k$ is a constant value, for $k = 1,2,...N$, and
- $V$ is a positive integer number with $1 \leq V \leq \log_2 N$.

65. (new): Device according to claim 64, characterised in that the number $C$ of chips of said optical codes is larger than or equal to the number $N$ of outputs $k$:
$$C \geq N.$$

66. (new): Device according to claim 64, characterised in that the number $N_C$ of optical codes which it is apt to simultaneously generate and process is larger than or equal to the number $N$ of outputs $k$:
$$N_C \geq N.$$

67. (new): Device according to claim 64, characterised in

2

that $N_k$ is an integer constant value, for $k = 1, 2, \ldots N$.

68. (new): Device according to claim 64, characterised in that the number $P$ of inputs $s$ is equal to 1:

$$P = 1.$$

69. (new): Device according to claim 64, characterised in that it comprises at least one tree having at least one node comprising a first coupler (21), including $N_{IN}$ input waveguides and $N_a$ output waveguides, with $N_{IN} \geq 1$ and $N_a \geq 1$, the outputs of which are connected to a grating (22) including $N_a$ waveguides, which are in turn connected to $N_a$ input waveguides of a second coupler (23), including $N_{OUT}$ output waveguides, where $N_{OUT} \geq 1$.

70. (new): Device according to claim 69, characterised in that

$$N_{IN} = N_a = N_{OUT} = N_{GRA}.$$

71. (new): Device according to claim 69, characterised in that a constant optical phase shifter of value $\Box_j$ is inserted along at least one of the waveguides $j$ of the grating (22) with $j = 1, 2, \ldots N_a$.

72. (new): Device according to claim 69, characterised in that the lengths $L_j$, with $j=1,2\ldots N_a$, of the waveguides of the grating (22), with $j=1,2\ldots N_a$, are equal to ([18])

$$L_j = L_{m'} + d_j \Delta L \qquad j = 1, 2, \ldots N_a$$

with the integer number $d_j \in [0, 1, 2, \ldots N_a - 1]$ satisfying the condition $d_k \neq d_{k'}$ if $k \neq k'$, where $L_{m'}$ is the length of a reference waveguide, equal to the shortest waveguide, whereby $d_{m'} = 0$, and $\Box L$ is the minimum difference between the lengths of two waveguides of the grating (22).

73. (new): Device according to claim 72, characterised in that ([33])

$$d_j = \left\{ \frac{1}{2} \left[ (-1)^{j+m'} \left( j - \frac{1}{2} \right) - \left( m' - \frac{1}{2} \right) \right] \right\} \bmod N_a \qquad m', j = 1, 2, \ldots N_a$$

where "mod" indicates the arithmetical module operator.

74. (new): Device according to claim 69, characterised in that $d_j = 2j$ with $j = 1, 2\ldots, N_a$, where only the even inputs $i$ ($i = 2r$, for $r = 1, 2, \ldots, int[N_{IN}/2]$, where "int" indicates the

arithmetical operator giving the integer quotient of a division) and the even outputs $k$ ($k = 2r'$, for $r'=1,2,\ldots,int[N_{OUT}/2]$) are used.

75. (new): Device according to claim 6, characterised in that the first coupler is a uniform Multi Mode Interference or MMI coupler (21).

76. (new): Device according to claim 69, characterised in that the first coupler is a non uniform power splitter MMI coupler (21).

77. (new): Device according to claim 75, characterised in that the first MMI coupler (21) has a length

$$L_c = M_c 3 L_\pi / N_a,$$

where $M_c$ is a positive integer number, and([13])

$$L_\pi = \frac{\pi}{\beta_0 - \beta_1} = \frac{4 n_g W_e^2}{3\lambda}$$

where
- $\Box_0$ and $\Box_1$ are propagation constants of the zeroth and first order modes, respectively,
- $n_g$ is the effective refractive index,
- $\Box$ is the free space wavelength of the input radiation, and
- $W_e$ is the effective width of the fundamental transverse mode, the device being further characterised in that, assuming that the first MMI coupler input waveguides are identified by an index $i$ which increases according to a transverse direction and that the output waveguides are identified by an index $j'$ which increases according to said same transverse direction, the input waveguides $i$ and the output waveguides $j'$ are located, respectively, in positions $x_i$ and $x_{j'}$ equal to ([14]):

$$x_i = (2i-1)\frac{W_e}{2N_{IN}} \qquad i = 1,2,\ldots N_{IN}$$

$$x_{j'} = (2j'-1)\frac{W_e}{2N_a} \qquad j'=1,2\ldots N_a$$

78. (new): Device according to claim 77, characterised in that $M_c$ and $N_a$ are two positive integer numbers without a common divisor larger than 1.

79. (new): Device according to claim 77, characterised in

that $M_c = 1$.

80. (new): Device according to claim 69, characterised in that the second coupler is a uniform MMI coupler (23).

81. (new): Device according to claim 69, characterised in that the second coupler is a non uniform power splitter MMI coupler (23).

82. (new): Device according to claim 80, characterised in that the second MMI coupler (23) has a length

$$L'_c = M'_c 3L'_\pi / N_{OUT},$$

where $M'_c$ is a positive integer number and ([13])

$$L'_\pi = \frac{\pi}{\beta'_0 - \beta'_1} = \frac{4n'_g W'^2_e}{3\lambda}$$

where
- $\beta'_0$ and $\beta'_1$ are propagation constants of the zeroth and first order modes, respectively,
- $n'_g$ is the effective refractive index,
- $\lambda$ is the free space wavelength of the input radiation, and
- $W'_e$ is the effective width of the fundamental transverse mode, the device being further characterised in that, assuming that the second MMI coupler input waveguides are identified by an index $j''$ which increases according to a transverse direction and that the output waveguides are identified by an index $k$ which increases according to said same transverse direction, the input waveguides $j''$ and the output waveguides $k$ are located, respectively, in positions $x'_{j''}$ and $x'_k$ equal to ([14]):

$$x'_{j''} = (2j''-1)\frac{W_e'}{2N_a} \qquad \text{for } j''=1,2,...,N_a$$

$$x'_k = (2k-1)\frac{W_e'}{2N_{OUT}} \qquad \text{for } k=1,2,...,N_{OUT}$$

83. (new): Device according to claim 82, characterised in that $M'_c$ and $N_{OUT}$ are two positive integer numbers without a common divisor larger than 1.

84. (new): Device according to claim 82, characterised in that $M'_c = 1$.

85. (new): Device according to claim 82, characterised in that

$$N_{IN} = N_a = N_{OUT} = N_{GRA},$$

a constant optical phase shifter of value $\square_j$ being inserted along at least one of the waveguides $j$ of the grating (22) with $j = 1, 2, \ldots N_a$, the first MMI coupler (21) having a length

$$L_c = M_c 3 L_\pi / N_a,$$

where $M_c$ is a positive integer number, and([13])

$$L_\pi = \frac{\pi}{\beta_0 - \beta_1} = \frac{4 n_g W_e^2}{3 \lambda}$$

where
- $\square_0$ and $\square_1$ are propagation constants of the zeroth and first order modes, respectively,
- $n_g$ is the effective refractive index,
- $\square$ is the free space wavelength of the input radiation, and
- $W_e$ is the effective width of the fundamental transverse mode, the device being further characterised in that, assuming that the first MMI coupler input waveguides are identified by an index $i$ which increases according to a transverse direction and that the output waveguides are identified by an index $j'$ which increases according to said same transverse direction, the input waveguides $i$ and the output waveguides $j'$ are located, respectively, in positions $x_i$ and $x_{j'}$ equal to ([14]):

$$x_i = (2i - 1) \frac{W_e}{2 N_{IN}} \qquad i = 1, 2, \ldots N_{IN}$$

$$x_{j'} = (2j' - 1) \frac{W_e}{2 N_a} \qquad j' = 1, 2 \ldots N_a$$

the values $\square_j$ of the phase shifters along the waveguides of the grating (22) being equal to ([20])

$$\varphi_{ij} + \varphi'_{jm} + \theta_j = 2\pi A_{ikm}$$

for $i = 1, 2, \ldots, N_{IN}$ $\quad j = 1, 2, \ldots, N_a$ $\quad m = 1, 2, \ldots, N_{OUT}$ $\quad k = 1, 2, \ldots, N_{OUT}$

where ([15])

$$\varphi_{ij} = \phi_1 - \frac{\pi}{2}(-1)^{i+j+N_{GRA}} + \frac{\pi}{4 N_{GRA}} \left[ i + j - i^2 - j^2 + (-1)^{i+j+N_{GRA}} \left( 2ij - i - j + \frac{1}{2} \right) \right]$$

with ([16])

$$\phi_1 = -\beta_0 \frac{3M_c L_\pi}{N_{GRA}} - \frac{9\pi}{8N_{GRA}} + \frac{3\pi}{4} \qquad,$$

and ([20])

$$\varphi'_{jm} = \phi'_1 - \frac{\pi}{2}(-1)^{j+m+N_{GRA}} + \frac{\pi}{4N_{GRA}}\left[ j + m - j^2 - m^2 + (-1)^{j+m+N_{GRA}}\left(2jm - j - m + \frac{1}{2}\right)\right]$$

with ([16])

$$\phi'_1 = -\beta'_0 \frac{3M'_c L'_\pi}{N_{GRA}} - \frac{9\pi}{8N_{GRA}} + \frac{3\pi}{4} \qquad,$$

where

$A_{ikm}$ are integer constants.

86. (new): Device according to claim 69, characterised in that the absolute value of the transfer function $T_{ik}(f)$ from an input $i$ of the first coupler to the output $k$ of the second coupler is a frequency translated copy of the absolute value of the reference transfer function $T_{im}(f)$, from the input $i$ of the first coupler (21) to an output $m$ of the second coupler (23), so that ([24]):

$$\left|T_{ik}(f)\right| = \prod_{v=0}^{V-1}\left|F_v\left(a_v f + \frac{S_{ik}}{N_k \tau}\right)\right| = \left|T_{im}\left(f - n\frac{c}{n_e N_k \Delta L}\right)\right|$$

for $i = 1,2,...,N_{IN}$ $\quad k, m = 1,2,...,N_{OUT}$

where:
- $F_0(f) = T_{im}(f)$,
- $c$ is the light speed,
- $a_v = 1$,
- $n_e$ is the refractive index of the waveguides of the grating (22),
- $V = 1$, and
- $S_{sk} = -n$, where $n$ is an integer number satisfying the condition that the values corresponding to two different outputs $k$ e $k'$ are different ([25]):

$$k \neq k' \rightarrow n \neq n' \qquad k, k' = 1,2,...,N_{OUT}$$

whereby the time constant $\tau$ is equal to:

7

$$\tau = \frac{\Delta L \cdot n_e}{c} \quad .$$

87.    (new):  Device according to claim 86, characterised in that $N_k = N_{OUT}$ for $k=1,2,…,$ $N_{OUT}$.

88.    (new):  Device according to claim 69, characterised in that the first coupler is a focusing coupler or "slab".

89.    (new):  Device according to claim 69, characterised in that the second coupler is a focusing coupler or "slab".

90.    (new):  Device according to claim 69, characterised in that the first coupler is a focusing coupler or "slab", the second coupler is a focusing coupler or "slab", and the location of the input and output waveguides on the first coupler and on the second coupler is based on the Rowland circle construction.

91.    (new):  Device according to claim 88, characterised in that the length of the adjacent waveguides in the grating varies by a constant $\Box L$.

92.    (new):  Device according to claim 88, characterised in that ([40]):

$$N_a = \frac{\lambda R}{n_s d d_o}$$

where:
-    $\lambda$ is the wavelength of the input optical signal,
-    $R$ is the focal length of the first and second focusing couplers,
-    $n_s$ is the effective refractive index of the first and second focusing couplers,
-    $d$ is the pitch of the waveguide grating, and
-    $d_o$ is the pitch of the $N_{IN}$ input waveguides and the $N_{OUT}$ output waveguides.

93.    (new):  Device according to claim 88, characterised in that, assuming that the $N_{IN}$ input waveguides and the $N_{OUT}$ output waveguides are identified, respectively, by an index $i$ and by an index $k$ which increase according to the same transverse direction, the absolute value of the transfer function $T_{ik}(f)$ from an input $i$ of the first coupler to the output $k$ of the second coupler is a frequency translated copy of the absolute value of a

8

reference transfer function $T_{im_{REF\_i}}(f)$, from the same input $i$ to a corresponding reference output $m_{REF\_i}$, with $1 \leq m_{REF\_i} \leq N_{OUT}$, so that ([44]):

$$|T_{ik}(f)| = \prod_{v=0}^{V-1} \left| F_v\left( a_v f + \frac{S_{ik}}{N_k \tau} \right) \right| = \left| T_{im_{REF\_i}}\left( f - \frac{i+k}{N_k \tau} \right) \right| \quad i = 1,2,...,N_{IN} \quad k = 1,2,...,N_{OUT}$$

where:
- $F_0(f) = T_{im_{REF\_i}}(f)$,
- $c$ is the light speed,
- $a_v = 1$,
- $n_e$ is the refractive index of the waveguides of the grating (22),
- $V = 1$,
- $S_{sk} = (i + k)$, and
- the time constant $\tau$ is equal to:

$$\tau = \frac{\Delta L \cdot n_e}{c} \quad .$$

94.    (new):  Device according to claim 93, characterised in that

$$N_{IN} = N_a = N_{OUT} = N_{GRA},$$

and in that the index $m_{REF\_i}$ of the reference output waveguide corresponding to the input $i$ is equal to:

$$m_{REF\_i} = \begin{cases} N_{GRA} - i & \text{for } i \neq N_{GRA} \\ N_{GRA} & \text{for } i = N_{GRA} \end{cases} \quad i = 1,2,...,N_{GRA}$$

95.    (new):  Device according to claim 93, characterised in that $N_k = N_{OUT}$ for $k=1,2,...,N_{OUT}$.

96.    (new):  Communication network, comprising one or more code generating devices (1), and one or more code processing and recognising devices (4, 5), characterised in that at least one of said one or more code generating devices (1) and/or at least one of said one or more code processing and recognising devices (4, 5) comprises at least one optical device (6), apt to generate and process optical codes at at least one wavelength, comprising $P$ inputs $s$, with $1 \leq s \leq P$, and $P \geq 1$, and $N$ outputs $k$, with $1 \leq k \leq N$

9

and $N \geq 1$, characterised in that it is apt to simultaneously generate and process $N_C$ phase and/or amplitude optical codes at one or more wavelengths, with $N_C \geq 2$, made of $C$ chips with time interval $\tau$, with $C \geq 2$, characterised in that the transfer function $T_{sk}(f)$ from the input $s$ to the output $k$ satisfies the following formula:

$$\left|T_{sk}(f)\right| = \prod_{v=0}^{V-1} \left|F_v\left(a_v f + \frac{S_{sk}}{N_k \tau}\right)\right| \quad , \quad \text{for} \quad s = 1,2..P \quad k = 1,2,...N$$

where:
- $F_v(f)$ is a transfer function of an optical filter, for $v = 0,1,...,V-1$,
- $a_v$ is a constant value, for $v = 0,1,...,V-1$,
- $S_{sk}$ is an integer number ($S_{sk} \in Z$),
- $N_k$ is a constant value, for $k = 1,2,...N$, and
- $V$ is a positive integer number with $1 \leq V \leq \log_2 N$.

97. (new): ommunication network according to claim 96, characterised in that said at least one optical device (6) is included within at least one of said one or more code generating devices (1) for associating at least one optical code (2) to one or more information optical signals (3).

98. (new): Communication network according to claim 96, characterised in that said at least one optical device (6) is included within at least one of said one or more code processing and recognising devices (4, 5) for controlling at least one optical switcher (13) on the basis of at least one recognised optical code (2).

99. (new): Communication network according to claim 98, characterised in that said at least one of said one or more code processing and recognising devices (4, 5) within which said at least one optical device (6) is included is a router device.

100. (new): Communication network according to claim 96, characterised in that it is a Multi Protocol Label Switching or MPLS communication network.

101. (new): Communication network according to claim 96, characterised in that it is a Code Division Multiple Access or CDMA communication network.

102. (new): Code generating device (1), characterised in that it comprises an optical device (6), apt to generate and process optical codes at at least one wavelength, comprising $P$ inputs $s$, with $1 \leq s \leq P$, and $P \geq 1$, and $N$ outputs $k$, with $1 \leq k \leq N$ and $N \geq 1$, characterised in that it is apt to simultaneously generate and process $N_C$ phase and/or amplitude optical codes at one or more wavelengths, with $N_C \geq 2$, made of $C$ chips with time interval $\tau$, with $C \geq 2$, characterised in that the transfer function $T_{sk}(f)$ from the input $s$ to the output $k$ satisfies the following formula:

$$\left| T_{sk}(f) \right| = \prod_{v=0}^{V-1} \left| F_v\left( a_v f + \frac{S_{sk}}{N_k \tau} \right) \right| \quad , \quad \text{for} \quad s = 1,2..P \quad k = 1,2,...N$$

where:
- $F_v(f)$ is a transfer function of an optical filter, for $v = 0,1,...,V-1$,
- $a_v$ is a constant value, for $v = 0,1,...,V-1$,
- $S_{sk}$ is an integer number ($S_{sk} \in Z$),
- $N_k$ is a constant value, for $k = 1,2,...N$, and
- $V$ is a positive integer number with $1 \leq V \leq \log_2 N$,

the code generating device being apt to be used in a communication network comprising one or more code generating devices (1), and one or more code processing and recognising devices (4, 5).

103. (new): Code processing and recognising device (4, 5), characterised in that it comprises an optical device (6) for controlling at least one optical switcher (13) on the basis of at least one recognised optical code (2), optical device (6) being apt to generate and process optical codes at at least one wavelength, comprising $P$ inputs $s$, with $1 \leq s \leq P$, and $P \geq 1$, and $N$ outputs $k$, with $1 \leq k \leq N$ and $N \geq 1$, characterised in that it is apt to simultaneously generate and process $N_C$ phase and/or amplitude optical codes at one or more wavelengths, with $N_C \geq 2$, made of $C$ chips with time interval $\tau$, with $C \geq 2$, characterised in that the transfer function $T_{sk}(f)$ from the input $s$ to the output $k$ satisfies the following formula:

$$\left|T_{sk}(f)\right| = \prod_{v=0}^{V-1}\left|F_v\left(a_v f + \frac{S_{sk}}{N_k\tau}\right)\right| \quad , \quad \text{for} \quad s = 1,2..P \quad k = 1,2,...N$$

where:
- $F_v(f)$ is a transfer function of an optical filter, for $v = 0,1,...,V-1$,
- $a_v$ is a constant value, for $v = 0,1,...,V-1$,
- $S_{sk}$ is an integer number ($S_{sk} \in Z$),
- $N_k$ is a constant value, for $k = 1,2,...N$, and
- $V$ is a positive integer number with $1 \le V \le \log_2 N$,

the code processing and recognising device (4, 5) being apt to be used in a communication network comprising one or more code generating devices (1), and one or more code processing and recognising devices (4, 5).

104. (new): Code processing and recognising device (4, 5) according to claim 103, characterised in that it is a router device.